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"The Right to Information, The Right to Live"

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IS 11006 (2011): Flash Back Arrestor (Flame Arrestor) [MED 16: Gas Cylinders]

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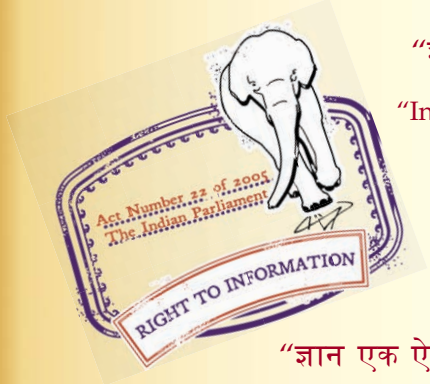

"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

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भारतीय मानक

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(पहला पुनरीक्षण)

Indian Standard

FLASH BACK ARRESTOR (FLAME ARRESTOR) — SPECIFICATION

(First Revision)

ICS 13.230; 23.040.80

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

October 2011 **Price Group 5**

Gas Cylinders Sectional Committee, MED 16

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Gas Cylinders Sectional Committee had been approved by the Mechanical Engineering Division Council.

The main purpose of the flash back arrestors or flame arrestors is to prevent the propagation of flame through it or any thing that is desired to be protected like storage tank, pipe line or generator.

A flash back arrestor or flame arrestor in investigated for the installation for which it is designed and for a general application.

This standard was first published in 1984. This revision is taken to include the following tests:

a) Flash back resistance;
b) Gas flow measurement;
c) Pressure cutout;
d) Pressure resistance;
e) Reverse flow; and
f) Temperature cutoff.

The composition of the Committee responsible for the formulation of this standard is given in Annex C.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values (*revised*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

FLASH BACK ARRESTOR (FLAME ARRESTOR) — SPECIFICATION

(First Revision)

1 SCOPE

This standard covers flash back arrestors for use in delivery pipe lines, acetylene generators, gas, petroleum, oil and gasoline or liquefied petroleum storage and or piping system and welding and cutting systems.

2 TERMINOLOGY

For the purpose of this standard the following definitions shall apply.

2.1 Flash Back Arrestor – It is a device to stop or arrest or prevent the return of the flame which can result in an explosion or of the blow back of the oxygenated gas from damaging whatever it is intended to protect. These devices may incorporate two or more safety functions.

2.2 These are further divided into two categories:

a) *Hydraulic back pressure valve or wet type flash back arrestor* — It is a flash back arrestor where the sealing is done by the help of liquid.

b) *Dry type flash back arrestor* — It is a device where the sealing is done by help of sintered metal or perforated discs or ceramic cartridge or by any means other than employing a liquid to arrest the flame.

2.3 Safety Seals — The flame arrestors or flash back arrestors are at times also referred as safety seals.

2.4 Safety Relief Device — It is a device intended to prevent rupture of the flame arrestor due to sudden built in pressure which can be in a form of safety valve, bursting disc or liquid seals connected to atmosphere.

2.5 Deflagration — It is a flame that travels into the unburnt gas at almost any velocity less than sonic.

2.6 Detonation — It is a flame that travels into the unburnt gas at a rate that is above the speed of sound.

2.7 Flash Back — It is the return of the flame into an apparatus or line and its propagation against the flow of the gas.

2.8 Maximum Operating Pressure — Maximum pressure to which the equipment may be put in service.

2.9 Non-return Valve — It prevents the flow to return from the down stream side.

2.10 Pressure-Sensitive Cut-off Valve — Device which stops the gas flow in the normal flow direction in the event of a back pressure wave from the downstream side.

2.11 Temperature-Sensitive Cut-off Valve — Device which stops the gas flow in the normal flow direction when a predetermined temperature is exceeded.

2.12 Flame Arrestors — Device which quenches a flame.

3 MATERIAL

3.1 The device shall be of a metal, resistant to corrosion or chemical reaction under condition of use. Where corrosion cannot be avoided suitable corrosion allowance shall be included in its thickness.

3.2 Gaskets shall be made of compressed asbestos fiber or metal spiral wound type or synthetic rubber which is compatible with the process gas.

4 CASING

4.1 The casing or housing shall be of non-fragmenting type made of forged steel, carbon steel or alloy steel pipe tube or plates, cast stainless steel, forged or extruded non-ferrous material or equivalent.

The casing or housing shall withstand the internal hydraulic pressure which is equal to ten times its maximum working pressure or 60 bars whichever is higher, without any permanent deformation or leaks when applied for a minimum period of 5 min.

4.2 The casing and the flat joints in a device or a flat surface in the device shall be free from any burrs or irregular surface or defects and shall preferably be machined to a fine finish.

5 FLANGED OR THREADED CONNECTIONS

The device shall have provisions for flanged or threaded connection to standard pipe which shall

conform to relevant standards for pressure rating to withstand the hydrostatic tests.

6 FLAME ARRESTOR SEALING MEDIUM

6.1 The sealing medium can be a liquid like water, or sintered or perforated metal or ceramic cartridge having good thermal conductivity, high porosity, large surface area and small pore size and shall be so constructed that, it quenches the flame.

6.2 The sealing medium shall be such that it does not react with the gas with which it is intended to be used and is safe for use under the operation condition.

6.3 Where a device relies wholly or partly on liquid sealing medium, means shall be provided for readily filling, observing and adjusting the level of the medium without introducing air into the system during operation.

7 VENT PIPE

Vent pipe or blow of outlet when provided shall be designed and constructed to prevent any choking or obstruction which could interfere with adequate venting. The discharge shall be safely dispersed.

8 SAFETY VALVES/BURSTING DISCS

If safety valves and bursting discs are provided they shall be designed for full flow type, and set at a pressure not more than 10 percent of the working pressure.

9 INTERNAL PARTS

The internal parts of the device shall be so constructed that the condition of the internal parts can be examined and maintained, if any maintenance is required.

10 REQUIREMENTS

10.1 General

Requirement of each safety device varies depending on its function and combination of these devices. A summary of requirements and tests are summarized in Table 1.

Table 1 Requirements and Tests

S1 No.	Safety Device Function	Requirements, Ref to Clause	Method of Test, Ref to Clause	Number of Devices Required for Each Test	Total Number of Devices Required
(1)	(2)	(3)	(4)	(5)	(6)
i)	Flame arrestor	**4.1**	**11.6**	5	7
		10.3	**11.4**	1	
		10.6	**11.9**	5	
ii)	Flame arrestor+	**10.2**	**11.4**	1	7
	non-return valve	**4.1**	**11.5**	5	
		10.4	**11.6**	5	
		10.6	**11.5**	5	
			11.9	5	
iii)	Flame arrestor +	**10.2**	**11.4**	1	8
	non-return valve+	**4.1**	**11.6**	5	
	temperature	**10.5**	**11.7**	1[1)]	
	sensitive				
	cut-off valve	**10.6**	**11.9**	5	
iv)	Flame arrestor +	**10.2**	**11.4**	1	8
	non-return valve+	**4.1**	**11.5**	5	
	temperature	**10.4**	**11.6**	5	
	sensitive	**10.5**	**11.5**	5	
	cut-off valve	**10.6**	**11.8**	5	
			11.9	5	
v)	Flame arrestor +	**10.2**	**11.4**	1	7
	non-return valve+	**4.1**	**11.5**	5	
	temperature	**10.4**	**11.8**	5	
	sensitive	**10.5**	**11.6**	5	
	cut-off valve+	**10.7**	**11.5**	5	
	pressure sensitive		**11.8**	5	
	cut-off valve		**11.7**	1[1)]	

[1)] Use a new device for this test. Do not use for any other test.

10.2 Internal Gas Tightness

Where internal gas tightness is required in this standard the leakage rate shall not exceed 50 cm^3/h for devices with a connection internal bore (diameter) less than 11 mm or 0.41 for larger diameters (*see* **11.5**).

NOTE — The value 0.41 d^2 is the flow in cm^3/h where d is the internal bore (diameter) in mm of the largest connection of the device. Alternatively at 10 percent of maximum operating pressure reverse flow it should have no leakage.

10.3 Flame Arrestor

Flame arrestors shall quench flashbacks when tested in accordance with **11.6**.

10.4 Flame Arrestor with Non-return Valve

Flame arrestor with non-return valve (*see* Fig. 1) shall quench flashbacks when tested in accordance with **11.6** and shall not allow the reverse flow of gases when tested in accordance with **11.5.2** both before and after the flashback test.

10.5 Flame Arrestor with Temperature Sensitive Cut-off Valve

Flame arrestor with temperature-sensitive cut-off valve (*see* Fig. 2) shall quench flashbacks when tested in accordance with **11.6** and shall stop the gas flow before the upstream gas is ignited when tested in accordance with **11.7**.

It shall not be possible to reset the temperature sensitive cut-off valve. If the temperature-sensitive cut-off valve operates before the fifth flashback in test and the flame is not transmitted upstream the unit shall be considered to meet the flashback test requirement, but test shall still be carried out on a new unit.

10.6 Gas Flow

The gas flow at maximum operating pressure for which the device with all its combinations shall operate should be the flow in m^3/h at a maximum pressure drop across the device by 10 percent of the maxim operating pressure.

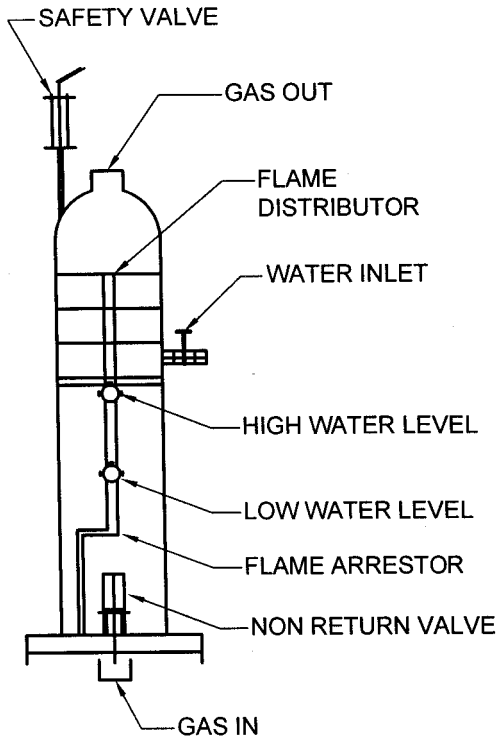


FIG. 1 TYPICAL WET TYPE FLASH BACK ARRESTOR WITH NON-RETURN VALVE AND FLAME ARRESTOR

10.7 Flame Arrestor with Pressure-Sensitive Cut-off Valve

Flame arrestor with pressure-sensitive cut-off valve (*see* Fig. 3) shall quench flashbacks when tested in accordance with **11.6** and the pressure-sensitive cut-off valve shall remain closed until manually reset.

The pressure-sensitive cut-off valve shall be reset after each flashback during test as per **11.6**.

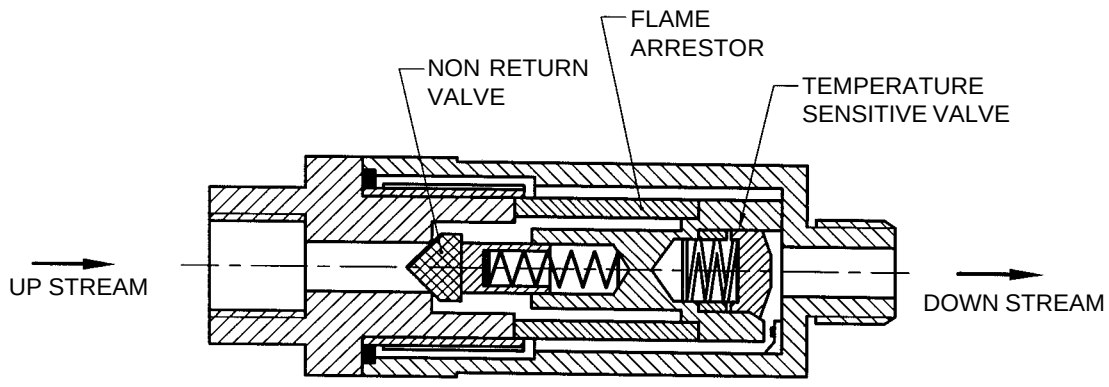


FIG. 2 TYPICAL FLASH BACK ARRESTOR HAVING NON-RETURN VALVE, FLAME ARRESTOR AND TEMPERATURE SENSITIVE CUT-OFF VALVE

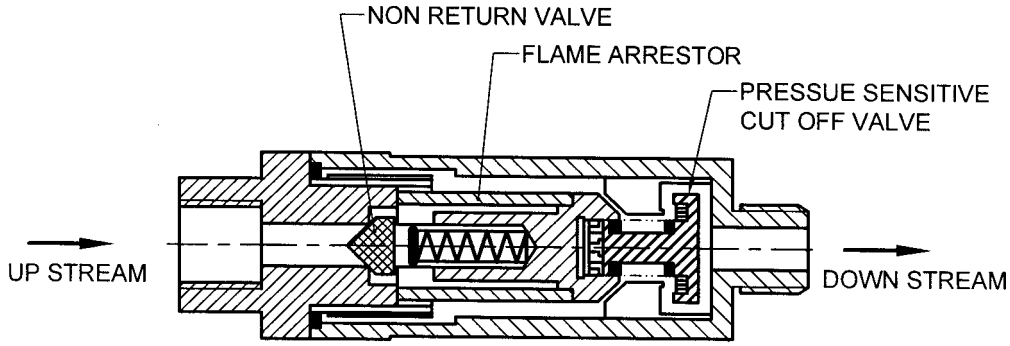


FIG. 3 TYPICAL FLASH BACK ARRESTOR HAVING NON-RETURN VALVE, FLAME ARRESTOR AND PRESSURE SENSITIVE CUT-OFF VALVE

Flame arrestor with pressure-sensitive cut-off valve shall also stop the gas flow when tested in accordance with **11.9** both before and after completing the flash back test.

11 METHODS FOR TYPE TESTING

11.1 General

The test methods in this section are not intended as production inspection tests, but are to be applied to sample devices to be tested for compliance with this standard. Tests shall be carried on new devices with all safety functions operational as designed.

11.2 Accuracy of Pressure and Flow Measurements

The allowable total error of the measured values is as follows:

a) Flow : + 10 percent

b) Pressure : + 3 percent

All flows and pressures shall be expressed in standard atmospheric conditions in accordance with relevant Indian Standards. All pressure values are given in gauge pressure, expressed in bars.

11.3 Test Gases

Unless otherwise stated, tests shall be carried out at ambient pressure conditions and at 27 ± 5 °C with air or nitrogen free from oil and grease.

Air is considered as oil-free if it comprises,

a) a mass fraction of oil vapour of less than 5×10^{-6}; and

b) less than 1 mg/m^3 of suspended droplets.

In all cases, tests shall be carried out with dry gas with maximum moisture content corresponding to a dew point of 0°C.

Safety devices for hydrogen shall be tested with hydrogen or helium for the gas tightness test only.

11.4 Pressure Resistance Test

Conformity with the requirements of **4.1** shall be checked by means of a hydraulic pressure test on one sample. No other tests shall be carried out on the sample either before or after this test nor shall the sample tested be used for any other purposes.

11.5 Non-return Valve Test

11.5.1 *General*

Conformity with the requirements of **10.4** shall be checked on five samples as follows. Before proceeding with this test, pass the test gas through the device in the normal direction of flow for 5 s to operate the valve. Connect the downstream side of the device under test to a gas source, with the upstream side at atmospheric pressure and connected to a leak detection device. Proceed to pressurize in the reverse direction according to **11.5.2**. For the tests, the samples shall be installed in the most disadvantageous position (gravity acting to open the valve).

11.5.2 *Tests with Reverse Flow of Gas*

Pressurize the device in the reverse direction as follows:

a) Increase the back-pressure at a rate of 6 mbar/min up to 10 percentage of the maximum working pressure, and

b) Increase the back-pressure within 1 s from 0 to maximum operating pressure.

The maximum reverse flow during the period of reverse pressure application and for 1 min afterwards shall meet the requirements of **10.2**.

When the device incorporates a pressure-sensitive cut-off valve, it is acceptable for the valve to operate during the non-return valve test.

11.6 Flame Arrestor Test

A diagram of the test equipment is shown in Fig. 4.

The gas mixture and pressure for testing flame arrestors depend on the gas application and the maximum operating pressure specified by the manufacturer (*see* Table 2).

Flame arrestors shall each be subjected to five flashbacks with a static mixture of fuel gas and oxygen given in Table 2.

Between two flash backs a sufficient delay is required to return to the initial conditions.

Each flame arrestor shall prevent the upstream gas igniting for all five flashbacks.

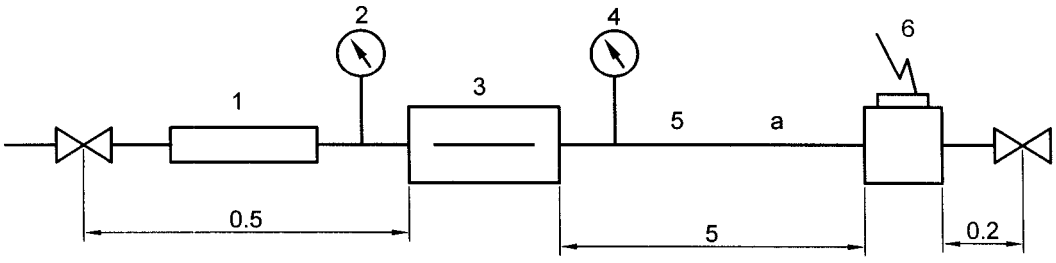
WARNING — All precautions shall be taken to protect personnel from the effect of fire and explosion.

11.7 Temperature-Sensitive Cut-off Valve Test

A diagram of the test equipment is shown in Fig. 5. This test is to be carried out on one new unit. The fuel gas used for the test shall be as given in Table 2. Adjust the fuel gas valve so that a flame at the outlet

Table 2 Gas Application and Test Pressure
(*Clauses* 11.6 *and* 11.7)

Sl No.	Gas Application	Test Pressure	Test Mixture Volume Fraction in (Percent) of Fuel Gas in Oxygen
(1)	(2)	(3)	(4)
i)	Acetylene oxygen air	Maximum operating pressure	32 percent to 35 percent acetylene
ii)	LPG	Maximum operating pressure	13 percent to 15 percent propane
iii)	Hydrogen	Maximum operating pressure	40 percent to 50 percent hydrogen
iv)	Other fuel gases	Maximum operating pressure stochiometric mixture	80 percent to 90 percent of



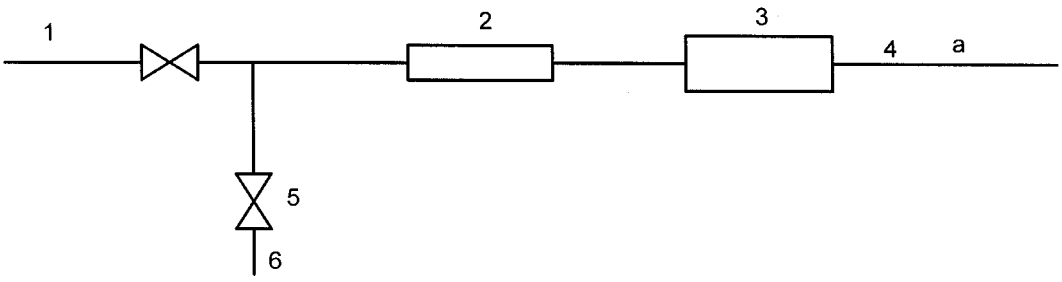
Key

1 — Flame Arrestor
2 — Inlet Pressure P_1
3 — Sample
4 — Outlet Pressure P_2
5 — Steel Tube
6 — Ignition Source

a — For Connection Internal Diameter of Pipe shall be Equal to Outlet Size of Device

All dimensions in metres.

FIG. 4 TEST EQUIPMENT FOR TESTING EFFICIENCY OF FLAME ARRESTOR



Key

1 — Fuel Gas
2 — Flame Detector
3 — Sample
4 — Steel Tube
5 — Needle Valve
6 — Oxygen

a — Pipe Nominal Bore will be Equal to Device Outlet Size

FIG. 5 TEST EQUIPMENT FOR TESTING TEMPERATURE SENSITIVE CUT-OFF VALVE

side of the steel tube is stable. Slowly open the oxygen valve until the flame retreats into the tube and device. The cut-off valve shall automatically cut-off the gas flow before the upstream gas is ignited.

When the device incorporates a pressure-sensitive cut-off valve which operates during the test, the pressure-sensitive cut-off valve shall be disabled and the test repeated.

11.8 Pressure-Sensitive Cut-off Valve Test

The requirements specified in **10.6** shall be checked on five samples as follows. Connect the downstream side of the device under test to a gas source, with the upstream side open to the atmosphere. Progressively increase the downstream pressure to check that the device is actuated by a pressure less than or equal to 1 200 mbar.

11.9 Gas Flow Measurement Test

The gas flow characteristic for each device can be measured by means of a performance test using the circuit shown in Fig. 6.

With the device discharging directly to the atmosphere, the upstream pressure should progressively be increased to the maximum operating pressure P_{Max}, and the gas flow rate and pressure drop measured at different intermediate pressure preferably at 0.25, 0.5, 0.75 of maximum operating pressure and at maximum operating pressure (*see* Fig. 7).

The gas to be used for this test shall be dry air or the gas for which the device is intended.

The average of the results obtained from 5 samples shall be considered to be the nominal value. The flow rates of the 5 samples should not diverge by more than 10 percent.

12 MANUFACTURER'S TEST

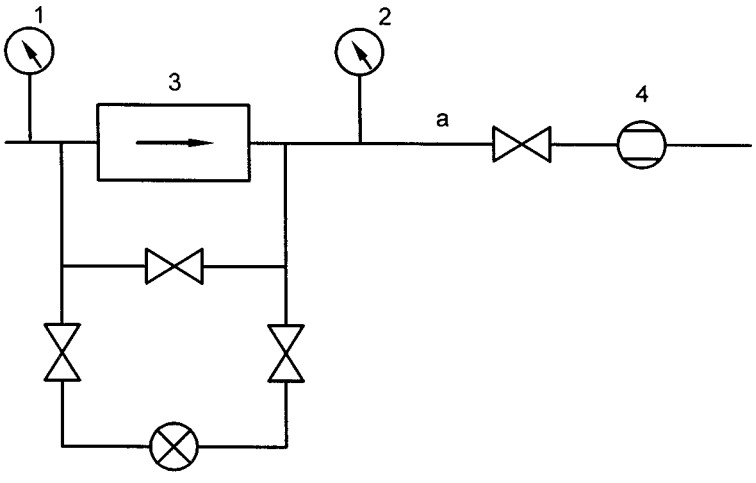
The following test should be carried out by the manufacturer on flash back arrestors confirming to this standard:

a) Test with reverse flow of gas for each device;
b) Pressure resistance test on one sample out of each lot of 100 samples; and
c) Flame arrestor test on one sample out of each lot of 100 samples.

13 MANUFACTURER'S INSTRUCTIONS

When distributed, the safety device shall be accompanied by the manufacturer's instructions which shall contain, as a minimum, the following information:

a) Function of the safety device;
b) Operational and performance data (maximum working pressure, gas flow characteristics, *see* Annex A;
c) Permissible types of gas;
d) An explanation of the abbreviations marked on the device;



Key

1 — Inlet Pressure P_1
2 — Outlet Pressure P_2
3 — Sample
4 — Flow Meter

a — Pipe Size Same as Device Outlet

FIG. 6 TYPICAL EXAMPLE OF CIRCUIT FOR GAS FLOW MEASUREMENT

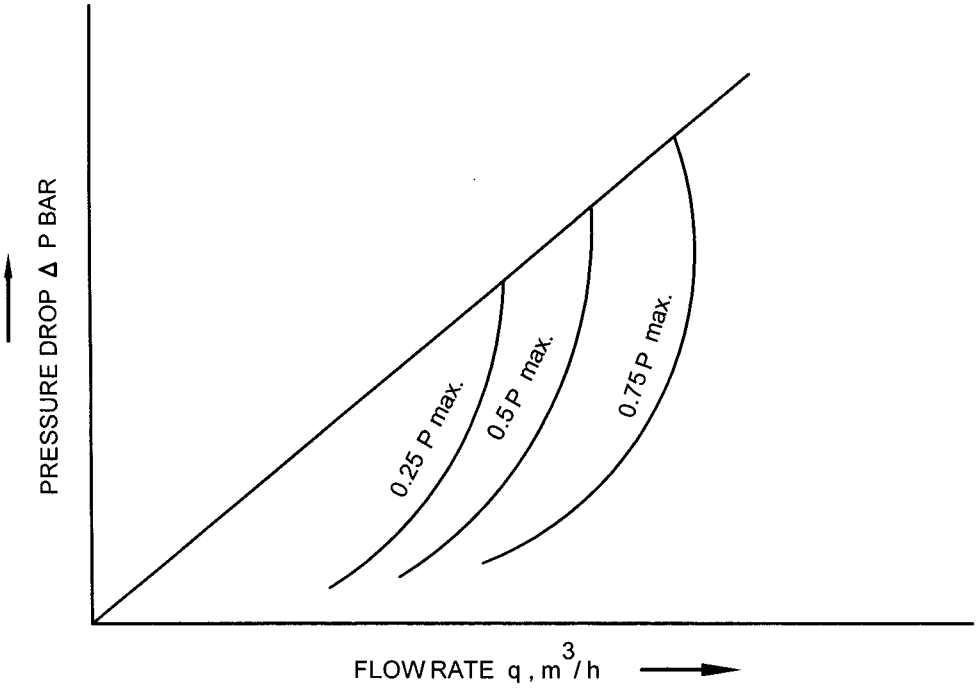


FIG. 7 GAS FLOW RATE AND PRESSURE DROP DURING GAS FLOW MEASUREMENT TEST

e) Instruction for installation of equipment — the method of installing these devices (types selected, order of installation, etc) varies with operating conditions. It is essential to follow the manufacturer's instructions regarding installation and operation to ensure that the overall pressure drop due to the combination is as low as possible;

f) Procedures to be carried out prior to operation,

g) Procedure for safe operation;

h) Instruction in case of malfunctioning; and

j) Recommendation for inspection, testing and maintenance.

14 MARKING

14.1 A flash back arrestor shall be clearly and permanently marked with the following:

a) Manufacturer's name or trade-mark;

b) Number of this standard;

c) Serial number;

d) Direction of nominal flow;

e) Name of gas or its abbreviation as given in Annex A;

f) Maximum operating pressure in bars; and

g) Safety functions as given in Annex B.

14.2 BIS Certification Marking

Each flash back arrestor may also be marked with the Standard Mark.

14.2.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. The details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers, may be obtained from the Bureau of Indian Standards.

ANNEX A
(*Clauses* 13 *and* 14.1)

GAS ABBREVIATION

A-1 For marking following abbreviation of gases shall be used.

Acetylene	:	A
Coal gas or town gas	:	C
Compressed air	:	D
Ethylene	:	E
Hydrogen	:	H
Methane or natural gas	:	M
Oxygen	:	O
LPG or propane	:	P

ANNEX B
(*Clause* 14.1)

MARKING OF SAFETY FUNCTIONS

B-1 The safety functions shall be marked and enclosed in boxes as follows:

Wet or dry type	:	W or D
Flame arrestor	:	F
Non-return valve	:	N
Pressure sensitive cut-off valve	:	P
Temperature sensitive cut-off valve	:	T

In case of multiple function the number of boxes will be added to one another for example

Acetylene, Dry type, Flame arrestor, Non-return valve will be A DFN

If, in addition, a colour coding band is used, red shall be used for fuel gases, blue for oxygen and for others black.

ANNEX C
(*Foreword*)

COMMITTEE COMPOSITION

Gas Cylinders Sectional Committee, MED 16

Organization	*Representative(s)*
Petroleum and Explosive Safety Organization, Nagpur	Shri Ajai Nigam (***Chairman***) Shri D. K. Gupta (*Alternate*)
All India Industrial Gases Manufacturers Association, New Delhi	Shri Karan Bhatia Shrimati Veena Peter (*Alternate*)
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Mahanagar Gas Limited, Mumbai	Shri Raghunath Kulai Shri Arun Nayak (*Alternate*)

Organization	*Representative(s)*
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Praxair India Ltd, Bangalore	Shri Milan Sarkar Shri Arindam Das (*Alternate*)
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SICGIL India Ltd, Chennai	Shri Farooque Dadabhoy Shri R. Padmanaban (*Alternate*)
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Steel Authority of India Ltd, Ranchi	Shri Debashis Karmakar Dr B. K. Jha (*Alternate*)
Supreme Cylinders Ltd, Delhi	Shri M. L. Fathepuria
Tekno Valves, Kolkata	Shri Y. K. Behani Shri R. Behani (*Alternate*)
Trans Valves (India) Pvt Ltd, Hyderabad	Shri A. K. Jain Shri Anuj Jain (*Alternate*)
Vanaz Engineers Ltd, Pune	Shri S. K. Khandekar Shri S. R. Sarvate (*Alternate*)
In personal capacity (*Menon & Patel, 14/1, Mile, Mathura Road, Faridabad*)	Shri Ebrahim M. Patel
In personal capacity (*303, Shantikunj, Pandav Bunglows Lane Athwalines, Surat*)	Shri L. D. Thakkar
BIS Directorate General	Shri C. K. Veda, Scientist 'F' and Head (MED) [Representing Director General (*Ex-officio*)]

Member Secretary

Shri Vishal Tomer
Scientist 'C' (MED)

Dissolved Acetylene Cylinders, Generators, Acetylene Pipe Lines and High Pressure Gas Cylinders Subcommittee, MED 16 : 3

BOC India Ltd, Kolkata	Shri Vutukuru Ramana (***Convener***)
Al-Can Exports Pvt Ltd, Distt Thane	Shri Vijay K. Parikh Shri D. C. Dave (*Alternate*)
All India Industrial Gases Manufacturers Association, New Delhi	Shri Karan Bhatia Shrimati Veen A. Peter (*Alternate*)
Bharat Pumps and Compressors Ltd, Allahabad	Shri J. P. Sinha Shri P. G. Choudhury (*Alternate*)
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Maruti Koatsu Cylinders Ltd, Mumbai	Shri Nitin J. Thakkar Shri A. S. Saran (*Alternate*)
Ministry of Defence (DGQA), Pune	Shri J. P. Tiwari Lt Col Ravi Kumar (*Alternate*)
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Rama Cylinders Pvt Ltd, Mumbai	Shri Sanjay R. Naphade Shri Sanjay S. Mande (*Alternate*)
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Headquarters:

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